6 - 14 Beam Commissioning of Superconducting Demo Facility

Wang Zhijun, Jia Huan, He Yuan, Dou Weiping, Wang Wangsheng,
Feng Chi, Liu Shuhui, Chen Weilong, Tao Yue and Wu Jianqiang

The demo facility of China ADS injector II was installed in the tunnel in 2014. The on-site layout of demo facility is shown in the Fig. 1. The demo facility mainly inculdes ECRIS, LEBT, RFQ, MEBTTCM and Dplate. The TCM is composed by one Superconducting(SC) HWR cavity and two SC solenoids.

The beam tuning began at September of 2014. The beam commissioning procedure mainly includes three steps. Calibration of single hardware. In this step, buncher cavity, SC HWR cavity and BPM offset are calibrated with beam to make sure the parameter of the hardwares agree with the off-line measured value. The beam parameters are chosen to be 10 mA, 1 Hz and less than 200 μs. From the results, the voltage of HWR cavity and buncher cavities agree well with the measurement with X-ray method. The offset between BPM electric center and quadruple magnetic center is less than 0.6 mm, which is reasonable according to the mechanical alignment result.

The beam parameters measurement and lattice setting. The transverse Twiss parameters of beam are very important for the setting of quadruples. The slits and wire scanners installed at the middle of MEBT are used to measure the transverse emittance and Twiss parameters directly. The initial Twiss parameters are calculated based on the measurement. The normalized RMS emittance is 0.27 and 0.28 pmm·mrad in horizontal and vertical direction. For the HWR cavity, the synchronous phase was set to be about zero degree to get maximum energy gain and no RF transverse defocusing. The beam energy and beam transmission were also measured.

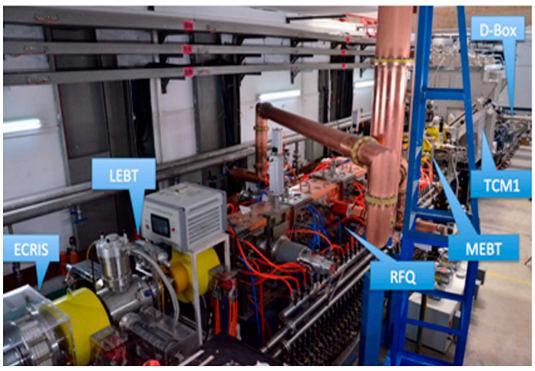

Fig. 1 (color online) On-site layout of demo facility.

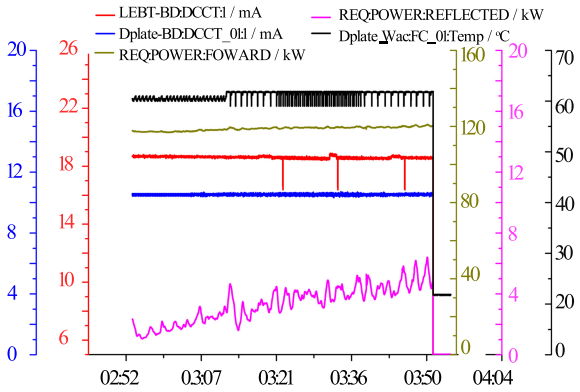

Fig. 2 (color online) The history record of the 10 mA CW operation.

Beam tuning. After lattice was determined, the beam was first tuned from pulse to CW, then from low beam current to 10 mA step by step. RFQ cavity frequency was reduced to compensate the beam loading effect. The water temperature was tuned to minimize the refection power of amplifier to keep stable operation of RFQ cavity. During beam tuning, temperature sensors along the beam line were used to detect beam losses at room- temperature.

In February 2015, we successfully achieved about 11 mA CW beam through the HWR cavity. The beam energy is 2.55 MeV and beam power reached 28 KW. The stable operation time lasted for about 1 h. Fig. 2 shows the history record of the 10 mA CW operation. It made a record for the highest CW beam current highest beam power among the same type linac all over the world.